

jc803 U.S. PTO
10/30/00

Patent
Attorney's Docket No. 004501-446

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

UTILITY PATENT
APPLICATION TRANSMITTAL LETTER

jc922 U.S. PTO
09/698234
10/30/00

Box PATENT APPLICATION
Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Enclosed for filing is the utility patent application of Otto PREISS and Dominik AUF DER MAUER for INTEGRATION OF A FIELD DEVICE IN AN INSTALLATION CONTROL SYSTEM.

Also enclosed are:

- ☒ 2 sheets of drawings;
- ☒ a claim for foreign priority under 35 U.S.C. §§ 119 and/or 365 is ☒ hereby made to Appln. No. 99810986.2 filed in Europe on November 1, 1999;
- ☐ in the declaration;
- ☐ a certified copy of the priority document;
- ☐ a General Authorization for Petitions for Extensions of Time and Payment of Fees;
- ☐ an Assignment document;
- ☐ an Information Disclosure Statement; and
- ☐ Other: _____
- ☒ An ☐ executed ☒ unexecuted declaration of the inventor(s)
- ☒ [X] also is enclosed ☐ will follow.
- ☒ Please amend the specification by inserting before the first line the sentence --This application claims priority under 35 U.S.C. §§ 119 and/or 365 to Appln. No. 99810986.2 filed in Europe on November 1, 1999; the entire content of which is hereby incorporated by reference.--
- ☐ A bibliographic data entry sheet is enclosed.
- ☐ Small entity status is hereby claimed.

☒ The filing fee has been calculated as follows ☐ and in accordance with the enclosed preliminary amendment:



21839

(10/00)

C L A I M S					
	NO. OF CLAIMS		EXTRA CLAIMS	RATE	FEE
Basic Application Fee					\$710.00 (101)
Total Claims	12	MINUS 20 =	0	× \$18.00 (103) =	
Independent Claims	3	MINUS 3 =	0	× \$80.00 (102) =	
If multiple dependent claims are presented, add \$270.00 (104)					
Total Application Fee					\$ 710.00
If small entity status is claimed, subtract 50% of Total Application Fee					
Add Assignment Recording Fee \$ if Assignment document is enclosed					
TOTAL APPLICATION FEE DUE					\$710.00

- [] This application is being filed without a filing fee. Issuance of a Notice to File Missing Parts of Application is respectfully requested.
- [X] A check in the amount of \$ 710.00 is enclosed for the fee due.
- [] Charge \$ _____ to Deposit Account No. 02-4800 for the fee due.
- [X] The Commissioner is hereby authorized to charge any appropriate fees under 37 C.F.R. §§ 1.16, 1.17 and 1.21 that may be required by this paper, and to credit any overpayment, to Deposit Account No. 02-4800. This paper is submitted in duplicate.

Please address all correspondence concerning the present application to:

Robert S. Swecker
BURNS, DOANE, SWECKER & MATHIS, L.L.P.
P.O. Box 1404
Alexandria, Virginia 22313-1404.

Respectfully submitted,

BURNS, DOANE, SWECKER & MATHIS, L.L.P.

Date: October 30, 2000

By: 

Robert S. Swecker
Registration No. 19,885

P.O. Box 1404
Alexandria, Virginia 22313-1404
(703) 836-6620

**Integration of a field device
in an installation control system**

5

DESCRIPTION

The invention relates to the field of installation control engineering, in particular substation control engineering for high-voltage, medium-voltage or low-voltage substations or switchgear assemblies. It relates to a method and a system for integration of a field device in an installation control system, as claimed in the precharacterizing clause of patent claims 1, 10 and 12.

An installation, in particular a high-voltage or medium-voltage substation, is controlled by a distributed installation control system from field devices which are connected to one another via communications buses. Figure 1 shows, schematically, a structure of an installation control system having field devices 1, a control station 2, a first and a second communications bus 3, 5 and a bus coupler 4. The field devices 1 control, regulate, monitor and protect primary units 6 in the installation which carry out the installation's actual purpose. Primary units 6 are, for example, switches, drives, generators or transformers. The bus coupler 4 connects communications buses 3, 5 which have different hardware and/or protocol characteristics, so that the communication buses 3, 4, 5 together form a communications network 3, 4, 5. The communications network 3, 4, 5 transmits messages for controlling the control station 2 to the field device 1 and messages from the field devices 1 to one another and to the control station 2 where, for example, they are displayed or stored. A field device 1 has at least one program element or one function for transmission of these messages associated with it in the control

- 2 -

station 2. This function must be aware how communication with the field device 1 can be carried out. Conversely, the field device 1 must also be aware how messages can be transmitted to the associated function.

In any description of this communication, a distinction is drawn between

- logic links, which describe transmitters; receivers and the nature of the message, and
- communications parameters, which describe how the transmission takes place.

Logic links are specified by unit identifications or network addresses. Communications parameters contain data types and data formats which are required when calling functions. Such information about a communications link is defined on an application layer in the generally known ISO communications layer model.

An individual message via a logic link between a field device 1 and an associated function conveys, for example, a position of a switch which is controlled by the field device 1, to an optical display within an installation diagram and/or to an event list and/or to an alarm function in the control station 2. A Standard for definition of communications links for station control engineering is described in a draft of an IEC Standard 61850. A summary of this can be found in the lecture documents relating to a VEW Energie AG Workshop of 1.21.99, by Jochen Haude.

During the configuration or engineering of an installation based on the prior art, device functions of the field device 1 and functions on a control station 2 are selected for integration of a field device 1, these functions are associated with one another, and logic links and communications parameters are specified. This is done by means of signal lists which specify in the form of text which functions of the control station 2 are associated with a specific

- 3 -

message or a specific signal from a field device 1. Entries for the signal lists are produced in a first step by configuration tools for the individual field device 1, in which case field devices 1 generally have
5 different configuration tools for protection functions and for control functions. In a second step, these entries are collected using an integration tool, and the signals are manually associated with one another. In a third step, specification data are produced for
10 the individual field devices 1 and the control station 2 and indicate a receiver address, based on the association, for each signal and each message. The specification data produced are stored in files which are respectively associated with the field device 1 and
15 the control station 2. During physical installation of a field device 1 and commissioning of the installation, these specification data are loaded in the field device 1 and in the control station 2. The appropriate communications links are thus produced, that is to say
20 are ready for use.

Despite the use of special development tools, a large amount of manual effort is, however, required for specification of the links and interactions between functions during planning and commissioning.
25 Furthermore, appropriate specialist knowledge is required in this case, so that, in addition to installation specialists, specialists in control engineering and communication are also required during planning and commissioning. Owing to the manual
30 processes and the complexity of an installation, errors occur, which result in increased commissioning effort and faults during operation. Retrospective corrections to the installation are difficult to carry out and are risky.

35

The object of the invention is therefore to provide a method and a system for integration of a field device in an installation control system of the

000001 4E2B6960

type mentioned initially, which avoid the disadvantages mentioned above.

This object is achieved by a method and a system for integration of a field device in an installation control system having the features of patent claims 1, 10 and 12.

In the method according to the invention for integration of a field device in an installation control system which has a communications network and a control station,

- the field device transmits a description of its device functions to the control station in a standardized form,
- functions associated with the field device are installed on the control station and logic communications links are produced automatically between the device functions and the functions of the control station.

Device functions are thus represented as software components which can not only carry out their functions associated with installation operation but also provide information about the device function itself and about configuration of the device function within the installation control system, in standardized form.

Communications links between field devices and associated functions in the control station are thus produced automatically during physical installation and commissioning, without corresponding logic links and communications parameters needing to be specified in a preceding planning phase.

One advantage of the invention is thus that no detailed logic links and communications parameters need be specified by hand, thus saving a large amount of effort in engineering. A further advantage is that a significant proportion of the engineering does not take place until physical installation and commissioning and that there is therefore no need to develop and store a

The device functions provided by the field device preferably allow access to all the data which are required for engineering and for configuration of

the field device within the installation control system. The functions carried out on the control station and associated with a field device are preferably interface functions for operation of the field device and for displaying data relating to the field device.

In one preferred variant of the invention, specific standard functions and corresponding logic links are installed automatically in the control station without any corresponding specification needing to be present in the installation structure or by the operator. For example, alarm functions and/or device functions which produce events are automatically connected to corresponding control station functions which process alarms and events, respectively.

In one advantageous variant of the invention, generic functions which can be associated with a field device are contained in the control station even before the physical installation of a field device. In another advantageous variant, such functions are stored in the field device and are transmitted to the control station during the physical installation of the field device. In a further advantageous variant, such functions and/or unit-specific data, such as an identification, are not stored in the field device itself, and only an address, for example a URL (Uniform Resource Locator) at which this information can be called is associated with the field device.

In one preferred variant of the invention the invention is used in high-voltage or medium-voltage switchgear assemblies. In installations such as this, interactions between the field devices are few in comparison with interactions between the field devices and control station so that, apart from the installation structure, only a small amount of further configuration data is required. A description language for unit communication in accordance with IEC Standard

- 7 -

61850-6, or its draft, is advantageously used in this variant.

Further preferred embodiments are evident from the dependent patent claims.

5

The invention will be explained in more detail in the following text with reference to preferred exemplary embodiments which are illustrated in the attached drawings, in which:

10

Figure 1 shows a structure of an installation control system, schematically;

Figure 2 shows a structure of a system according to the invention, schematically; and

15

Figure 3 shows a line diagram of a switchgear assembly.

The reference symbols used in the drawings and their meanings are listed in summarized form in the list of reference symbols. In principle, identical parts are provided with identical reference symbols in the figures.

20

Figure 2 shows a structure of a system according to the invention, schematically. One or more field devices 1 are connected to at least one control station 2 via a communications network which is formed from one or more communications buses 3,5 and bus couplers 4.

25

Field devices 1 are control engineering or secondary units. They are used for controlling, regulating and protecting a primary unit 6. Primary units 6 are units which carry out an actual function of an installation, for example circuit breakers, isolators, overhead lines, transformers, generators, motors, turbines, pumps etc.

30

35

At least one device function 11 is stored and can be carried out in a field device 1. The device function 11 comprises an external interface 12 for

communication with other control engineering units, algorithms 14 for controlling, regulating, monitoring and protecting the primary unit 6, and an internal interface 15 for driving the primary unit 6. According to the invention, the device function 11 has a functional description 13, which describes the device function 11 itself, as well as its parameters. This description is preferably laid out in accordance with the draft of IEC Standard 61850-6, or the adopted Standard.

In one variant of the invention, in accordance with an object model in the draft of IEC Standard 61850-7, a physical field device has one or more logic field devices. In this case, logic field devices correspond to field devices 1, as the term is used in the following text.

The control station 2 has an engineering application 21 for integration of field devices 1 and for commissioning of the installation, an installation representation 22 with information about a structure and communications links of the installation, and an input/output unit 25 for representing and for manipulating data for the installation representation 22. The input/output unit 25 is connected to a display unit 27, for example a screen, and to an input unit 26, for example a keyboard and/or a pointing device.

In a first preferred variant of the invention, integration of a field device 1 runs as follows: when the installation of field devices 1 starts, the installation control system has the communications network 3, 4, 5 and the control station 2, with the installation structure 24 not yet being represented in the control station 2. A field device 1 is connected to the communications network. The field device 1 uses a registry service to register its existence in the communications network in a generally known manner, for example by means of a broadcast or multicast method: in this case, the network provides a logic channel on

- 9 -

which each unit can transmit its presence, its network address and an identity. In a broadcast method, all the units connected to the network receive this information, while in a multicast method, only a subset of units receive this information, that is to say the control station 2 in the present invention. On the basis of the registration of the field device 1, the control station 2 transmits to the field device 1 a request to transmit the functional description 13 of the unit, and the unit then transmits the functional description 13 to the control station 2. This description is preferably laid out in accordance with IEC Standard 61850-6, or its draft. This Standard describes definitions of communications links for station control engineering. It uses an approach and terminology based on a "Client/Server" model, in which servers provide services or functions. Thus, in particular, field devices 1 are regarded as servers which provide their device functions 11 as services. The device functions 11 allow a field device 1 to be controlled by another unit, for example by a higher-level control station 2. To do this, the services or device functions 11 are called by client program elements 23, 23' which are executed, for example, on a control station 2.

The text below, which is explained in what follows, shows the contents of a functional description 13 of device functions 11 of a physical field device which has two logic field devices. The line numbers are not part of the description and have been added for explanatory purposes.

```

1    <?xml version="1.0"?>
2    <!-- SCL Version 0.2 -->
3    <!DOCTYPE STATION SYSTEM "scl.dtd">
35  4    <STATION>
5    <BUS name="IBB" type="IEC61850" />
6    <NODE   name="J01Cnt1"   type="REC316"   bus="IBB"
      addr="47"> <!-- Control -->

```

[illegible][illegible]

Table 1. Summary of the data used in the study	
Study	1997-1998
Location	1997-1998
Sample size	1997-1998
Study design	1997-1998
Study population	1997-1998
Study area	1997-1998
Study period	1997-1998
Study results	1997-1998
Study conclusions	1997-1998
Study limitations	1997-1998
Study strengths	1997-1998
Study impact	1997-1998
Study relevance	1997-1998
Study significance	1997-1998
Study contribution	1997-1998
Study value	1997-1998
Study importance	1997-1998
Study utility	1997-1998
Study effectiveness	1997-1998
Study efficiency	1997-1998
Study quality	1997-1998
Study reliability	1997-1998
Study validity	1997-1998
Study accuracy	1997-1998
Study precision	1997-1998
Study consistency	1997-1998
Study comparability	1997-1998
Study generalizability	1997-1998
Study applicability	1997-1998
Study transferability	1997-1998
Study adaptability	1997-1998
Study flexibility	1997-1998
Study robustness	1997-1998
Study resilience	1997-1998
Study sustainability	1997-1998
Study replicability	1997-1998
Study reproducibility	1997-1998
Study verifiability	1997-1998
Study auditability	1997-1998
Study transparency	1997-1998
Study accountability	1997-1998
Study responsibility	1997-1998
Study integrity	1997-1998
Study honesty	1997-1998
Study fairness	1997-1998
Study justice	1997-1998
Study equity	1997-1998
Study inclusion	1997-1998
Study participation	1997-1998
Study engagement	1997-1998
Study collaboration	1997-1998
Study partnership	1997-1998
Study alliance	1997-1998
Study coalition	1997-1998
Study network	1997-1998
Study community	1997-1998
Study society	1997-1998
Study culture	1997-1998
Study values	1997-1998
Study beliefs	1997-1998
Study attitudes	1997-1998
Study behaviors	1997-1998
Study actions	1997-1998
Study decisions	1997-1998
Study outcomes	1997-1998
Study impacts	1997-1998
Study effects	1997-1998
Study consequences	1997-1998
Study results	1997-1998
Study findings	1997-1998
Study conclusions	1997-1998
Study recommendations	1997-1998
Study suggestions	1997-1998
Study proposals	1997-1998
Study plans	1997-1998
Study strategies	1997-1998
Study policies	1997-1998
Study procedures	1997-1998
Study protocols	1997-1998
Study guidelines	1997-1998
Study standards	1997-1998
Study norms	1997-1998
Study conventions	1997-1998
Study customs	1997-1998
Study traditions	1997-1998
Study practices	1997-1998
Study habits	1997-1998
Study routines	1997-1998
Study patterns	1997-1998
Study trends	1997-1998
Study movements	1997-1998
Study changes	1997-1998
Study developments	1997-1998
Study progress	1997-1998
Study growth	1997-1998
Study expansion	1997-1998
Study increase	1997-1998
Study improvement	1997-1998
Study enhancement	1997-1998
Study optimization	1997-1998
Study maximization	1997-1998
Study minimization	1997-1998
Study reduction	1997-1998
Study decrease	1997-1998
Study decline	1997-1998
Study drop	1997-1998
Study fall	1997-1998
Study loss	1997-1998
Study damage	1997-1998
Study harm	1997-1998
Study injury	1997-1998
Study pain	1997-1998
Study suffering	1997-1998
Study distress	1997-1998
Study discomfort	1997-1998
Study inconvenience	1997-1998
Study annoyance	1997-1998
Study frustration	1997-1998
Study anger	1997-1998
Study rage	1997-1998
Study fury	1997-1998
Study wrath	1997-1998
Study hatred	1997-1998
Study loathing	1997-1998
Study contempt	1997-1998
Study scorn	1997-1998
Study derision	1997-1998
Study mockery	1997-1998
Study ridicule	1997-1998
Study sarcasm	1997-1998
Study irony	1997-1998
Study humor	1997-1998
Study amusement	1997-1998
Study entertainment	1997-1998
Study enjoyment	1997

Table 1. Summary of the data used in the study	
Study	1997-1998
Location	1997-1998
Sample size	1997-1998
Study design	1997-1998
Study population	1997-1998
Study area	1997-1998
Study period	1997-1998
Study results	1997-1998
Study conclusions	1997-1998
Study limitations	1997-1998
Study strengths	1997-1998
Study impact	1997-1998
Study relevance	1997-1998
Study significance	1997-1998
Study contribution	1997-1998
Study value	1997-1998
Study importance	1997-1998
Study utility	1997-1998
Study effectiveness	1997-1998
Study efficiency	1997-1998
Study quality	1997-1998
Study reliability	1997-1998
Study validity	1997-1998
Study accuracy	1997-1998
Study precision	1997-1998
Study consistency	1997-1998
Study comparability	1997-1998
Study generalizability	1997-1998
Study applicability	1997-1998
Study transferability	1997-1998
Study adaptability	1997-1998
Study flexibility	1997-1998
Study robustness	1997-1998
Study resilience	1997-1998
Study sustainability	1997-1998
Study replicability	1997-1998
Study reproducibility	1997-1998
Study verifiability	1997-1998
Study auditability	1997-1998
Study transparency	1997-1998
Study accountability	1997-1998
Study responsibility	1997-1998
Study integrity	1997-1998
Study honesty	1997-1998
Study fairness	1997-1998
Study justice	1997-1998
Study equity	1997-1998
Study inclusion	1997-1998
Study participation	1997-1998
Study engagement	1997-1998
Study collaboration	1997-1998
Study partnership	1997-1998
Study alliance	1997-1998
Study coalition	1997-1998
Study network	1997-1998
Study community	1997-1998
Study society	1997-1998
Study culture	1997-1998
Study values	1997-1998
Study beliefs	1997-1998
Study attitudes	1997-1998
Study behaviors	1997-1998
Study actions	1997-1998
Study decisions	1997-1998
Study outcomes	1997-1998
Study impacts	1997-1998
Study effects	1997-1998
Study consequences	1997-1998
Study results	1997-1998
Study findings	1997-1998
Study conclusions	1997-1998
Study recommendations	1997-1998
Study suggestions	1997-1998
Study proposals	1997-1998
Study plans	1997-1998
Study strategies	1997-1998
Study policies	1997-1998
Study procedures	1997-1998
Study protocols	1997-1998
Study guidelines	1997-1998
Study standards	1997-1998
Study norms	1997-1998
Study conventions	1997-1998
Study customs	1997-1998
Study traditions	1997-1998
Study practices	1997-1998
Study habits	1997-1998
Study routines	1997-1998
Study patterns	1997-1998
Study trends	1997-1998
Study movements	1997-1998
Study changes	1997-1998
Study developments	1997-1998
Study progress	1997-1998
Study growth	1997-1998
Study expansion	1997-1998
Study increase	1997-1998
Study improvement	1997-1998
Study enhancement	1997-1998
Study optimization	1997-1998
Study maximization	1997-1998
Study minimization	1997-1998
Study reduction	1997-1998
Study decrease	1997-1998
Study decline	1997-1998
Study drop	1997-1998
Study fall	1997-1998
Study loss	1997-1998
Study damage	1997-1998
Study harm	1997-1998
Study injury	1997-1998
Study pain	1997-1998
Study suffering	1997-1998
Study distress	1997-1998
Study discomfort	1997-1998
Study inconvenience	1997-1998
Study annoyance	1997-1998
Study frustration	1997-1998
Study anger	1997-1998
Study rage	1997-1998
Study fury	1997-1998
Study wrath	1997-1998
Study hatred	1997-1998
Study loathing	1997-1998
Study contempt	1997-1998
Study scorn	1997-1998
Study derision	1997-1998
Study mockery	1997-1998
Study ridicule	1997-1998
Study sarcasm	1997-1998
Study irony	1997-1998
Study humor	1997-1998
Study amusement	1997-1998
Study entertainment	1997-1998
Study enjoyment	1997

[illegible][illegible]

Table 1. Summary of the data used in the study	
Study	1997-1998
Location	1997-1998
Sample size	1997-1998
Study design	1997-1998
Study population	1997-1998
Study variables	1997-1998
Study results	1997-1998
Study conclusions	1997-1998
Study limitations	1997-1998
Study strengths	1997-1998
Study implications	1997-1998
Study relevance	1997-1998
Study significance	1997-1998
Study impact	1997-1998
Study contribution	1997-1998
Study value	1997-1998
Study importance	1997-1998
Study utility	1997-1998
Study effectiveness	1997-1998
Study efficiency	1997-1998
Study quality	1997-1998
Study reliability	1997-1998
Study validity	1997-1998
Study accuracy	1997-1998
Study precision	1997-1998
Study consistency	1997-1998
Study comparability	1997-1998
Study generalizability	1997-1998
Study applicability	1997-1998
Study transferability	1997-1998
Study adaptability	1997-1998
Study flexibility	1997-1998
Study robustness	1997-1998
Study resilience	1997-1998
Study sustainability	1997-1998
Study replicability	1997-1998
Study reproducibility	1997-1998
Study verifiability	1997-1998
Study auditability	1997-1998
Study transparency	1997-1998
Study accountability	1997-1998
Study responsibility	1997-1998
Study integrity	1997-1998
Study honesty	1997-1998
Study fairness	1997-1998
Study justice	1997-1998
Study equity	1997-1998
Study inclusion	1997-1998
Study participation	1997-1998
Study engagement	1997-1998
Study collaboration	1997-1998
Study partnership	1997-1998
Study alliance	1997-1998
Study coalition	1997-1998
Study network	1997-1998
Study community	1997-1998
Study society	1997-1998
Study culture	1997-1998
Study values	1997-1998
Study beliefs	1997-1998
Study attitudes	1997-1998
Study behaviors	1997-1998
Study actions	1997-1998
Study decisions	1997-1998
Study outcomes	1997-1998
Study impacts	1997-1998
Study effects	1997-1998
Study consequences	1997-1998
Study results	1997-1998
Study findings	1997-1998
Study conclusions	1997-1998
Study recommendations	1997-1998
Study suggestions	1997-1998
Study proposals	1997-1998
Study plans	1997-1998
Study strategies	1997-1998
Study policies	1997-1998
Study procedures	1997-1998
Study protocols	1997-1998
Study guidelines	1997-1998
Study standards	1997-1998
Study norms	1997-1998
Study conventions	1997-1998
Study customs	1997-1998
Study traditions	1997-1998
Study practices	1997-1998
Study habits	1997-1998
Study routines	1997-1998
Study schedules	1997-1998
Study timelines	1997-1998
Study calendars	1997-1998
Study diaries	1997-1998
Study journals	1997-1998
Study notebooks	1997-1998
Study portfolios	1997-1998
Study collections	1997-1998
Study archives	1997-1998
Study libraries	1997-1998
Study databases	1997-1998
Study repositories	1997-1998
Study registries	1997-1998
Study directories	1997-1998
Study indexes	1997-1998
Study catalogs	1997-1998
Study lists	1997-1998
Study tables	1997-1998
Study charts	1997-1998
Study graphs	1997-1998
Study diagrams	1997-1998
Study maps	1997-1998
Study images	1997-1998
Study videos	1997-1998
Study audio	1997-1998
Study text	1997-1998
Study data	1997-1998
Study information	1997-1998
Study knowledge	1997-1998
Study wisdom	1997-1998
Study understanding	1997-1998
Study insight	1997-1998
Study perception	1997-1998
Study cognition	1997-1998
Study thought	1997-1998
Study idea	1997-1998
Study concept	1997-1998
Study notion	1997-1998
Study theory	1997-1998
Study model	1997-1998
Study framework	1997-1998
Study structure	1997-1998
Study system	1997-1998
Study mechanism	1997-1998
Study process	1997-1998
Study method	1997-1998
Study technique	1997-19

[illegible][illegible][illegible]

- 11 -

the identification ("J01Cnt1") and a communication address ("47").

Line 7: The start of a description of a server which provides services or device functions 11 of the first logic field device. Since the first logic field device has only one server, there is no need to specify a name.

Line 8: A name ("Q0") or an identification of a "logical node", which corresponds to a device function 11 of the (logic) field control unit. A type of function ("CCBC") states that this relates to actuation of a switch.

Lines 9-11: Names or identifications and types of device functions 11 for actuation of disconnectors.

Line 12: The end of the description of the server.

Line 13: The end of the description of the first logic field device.

Lines 14-20: An analog description of a second logic field device, which provides device functions 11 for detecting overcurrents and for distance protection, as well as reclosing functions.

Line 21: The end of the description of the station.

On the basis of the types of device functions 11, the control station 2 is aware of what services these device functions 11 provide and what data types they require. In this case, the services, data types etc... preferably correspond to draft IEC Standard 61850. By way of example, for a device function XCBR for actuation of a switch, the Standard defines that said device function XCBR has the following services:

- **ODSw** for controlling the switch, of DPC Type.
- **Pos** for reading the switch state, of DPS Type.
- **MDD** for "motor drive disturbance" fault indication, of SPS Type.
- **SF6GasDen** for "SF6 density warning" fault indication, of SPS Type.

- 12 -

where the Types used, with their attributes are:

- **DPC** double point control, with attributes for, for example, type (status, measured value, control value, set value), value (activation, deactivation, invalid, undefined), execution time, duration and number of repetitions of control pulses,
- **DPS** double point status, with attributes for type, status (true, false, intermediate value, invalid), quality (invalid, transmission error, blocked, replaced, overflow, etc...), time stamp and descriptive text, and
- **SPS** single point status, with similar attributes to DPS.

The definition also covers, for example by means of the Standard, what data types or structures each of these services requires. A call to a service by the control unit 2 corresponds to a logic link between the control unit 2 and the field device 1. A logic link is described by the transmitter, receiver and nature of a message or of a service. Communication parameters for a link are described by the data types and data formats.

On the basis of this functional description 13, the engineering application 21 now knows which device functions 11 the newly connected field device 1 has, what type of logic links can be set up in accordance with these device functions 11 for the field device 1, and which communications parameters these logic links have.

The engineering application 21 then instantiates one or more associated functions of the control station 23. These functions of the control station 23 are represented, for example, by program elements, by data structures or by objects in the sense of object-oriented programming methodology. The functions of the control station 23 are, for example, "operation of a switch", "reading a state", "plotting a

- 13 -

trend curve of a measurement variable", "entry in an event list", "initiation of an alarm", etc... The types of functions of the control station 23 which can be associated with a specific device function 11 are defined, for example, in accordance with the cited Standard. All the functions or else a predefined set of functions which can be associated with a specific device function 11 are preferably instantiated first of all. According to the Standard, it is known what type of primary unit 6 is associated with the device function 11. A software representation of this primary unit 6, that is to say a primary unit representation, is likewise instantiated in the installation representation 22.

After registration by one or more field devices 1, the installation representation 22 contains a set of primary unit representations and functions of the control station 23, which are all associated with in each case one specific field device 1 or its device functions 11. However, the installation representation 22 has no information about the installation structure. This information is now specified by an operator. To do this, the input/output unit 25 produces a preferably graphic display of the primary unit representations on the display unit 27. The user uses the input unit 26 in a known way to create a graphics representation of the installation structure interactively from the primary unit representations. The operator in this case requires information for this process as to where a primary unit 6 or an associated field device 1 with a specific identification is located in the installation. The resulting representation is represented as an installation structure 24 on the computer.

One such representation, by way of example, is a line diagram, as is shown in Figure 3. The line diagram shows bus bars 31, isolating switches 32, switches 33, a current transformer 34, voltage transformer 35, generator 36, three-winding transformer

000001 42255360

- 14 -

37, motor 38, two-winding transformer 39 and circuit breakers with truck 40. These primary units are represented by the symbols shown in the graphics illustration.

5 During the production of the installation structure 24, the representation has other graphics elements which are not shown in Figure 3, for example for identification of primary units 6, for symbols and identification of field devices 1 and for associations
10 between primary units 6 and field devices 1.

Certain functions of the control station 23 are automatically linked to the representation of the associated primary unit representation in the installation structure 24 by the engineering
15 application 21, on the basis of the nature of the function. When the installation is in operation, after commissioning, functions for operating a switch or functions for calling a state, for example, are then called by selecting the appropriate primary unit
20 representation in the representation of the installation structure 24.

Other functions of the control station 23 are manually and/or automatically associated with specific data structures or specific graphics elements in the
25 display, by the engineering application 21, on the basis of their nature. For example, functions of the control station 23 which receive events from primary units 6 are combined, so that the events are entered in a common event list. Alternatively, a number of alarm
30 functions are combined, so that a common alarm display is actuated.

On the basis of the known network address of the field device 1, the engineering application 21 signals this address to the functions of the control
35 station 23, and signals an address of the associated functions of the control station 23 to the field device 1. Addresses are represented, for example, by section bus addresses or by entries in an SCADA database for

000007 42266660

- 15 -

administration of an SCADA (Supervisory Control and Data Acquisition) system. The communications links between device functions 11 and functions of the control station 23 are configured by this distribution of addresses. The functions configured in such a way are installed in the field device 1 or in the control station 2 as appropriate, that is to say are stored in an executable form.

If necessary, communications links between field devices 1 are likewise specified interactively and graphically, on the basis of representation of the functions of the control station 23, 23'. Such communication between field devices 1 is required, for example, for mutual interlocking of switches in a switchgear assembly. Dedicated field devices 1, which have no significant interactions with other field devices 1, are provided for certain higher-level functions, such as bus bar protection. In consequence, there are few interactions between the field devices 1 in switchgear assemblies in comparison with the interactions between the field devices 1 and the control station 2, so that, apart from the installation structure 24, only a small amount of further configuration data is required.

The majority of the control engineering software in the control station 2 required for operation of the system, that is to say the logic links between device functions 11 and the functions of the control station 23 and to a graphics user interface, was produced by the steps described above with minimal manual effort. The control engineering software produced and its functions are installed on the control station 2, for operation of the installation.

In a second preferred variant of the invention, integration of a field device 1 takes place in the same way as in the first variant, but with the difference that the installation structure 24 is already in computer-legible form. Instead of interactive

- 16 -

specification of the installation structure 24, the only task remaining for the operator is to assign a primary unit representation, which has been produced on the basis of a connected field device 1, to a primary unit representation of the installation structure 24. This is done, for example, by means of a known graphics "drag and drop" association process. In this case as well, the operator requires the information as to where a primary unit 6 or an associated field device 1 with a specific identification is located in the installation.

In a third preferred variant of the invention, integration of a field device 1 is carried out as in the second variant, but with the installation structure 24 now also containing identifications of the primary units 6 and/or of the field devices 1. The association with connected units is thus automated and the steps described in the first two variants for manual specification of the installation structure 24 and association of primary unit representations are not required.

In the variants of the invention described above, class descriptions of functions of the control station 23, which are used as a basis for instantiation, that is to say generic device functions which can be associated with a field device 1, are included in the control station 2 even before the physical installation of a field device 1. In another advantageous variant, such generic device functions are stored in the field device 1 and are transmitted to the control station 2 during the physical installation of the field device 1. This has the advantage that the control station 2 requires even less a priori information about an installation and its equipment before installation and commissioning. In a further advantageous variant, equipment-specific device functions 11 and/or data such as identification are not stored in the field device itself, but the field device is assigned only one address, for example a URL

- 17 -

(Uniform Resource Locator). This information can be called by means of this address via the communications network or, for example, via a network which is connected to the communications network but extends beyond the installation.

During operation of the installation, the device functions 11 and the functions of the control station 23 are connected to one another and are connected to an interactive visual representation of the installation structure 24 on the basis of the specifications on which the commission process is based or which are implemented manually. Control and coordination at the installation level are thus carried out by the control station 2. The engineering application 21 is no longer required.

In the examples described so far, only one control station 2 is mentioned. Communication can, of course, also be set up to more than one control station 2 of an installation control system according to the invention. In this case, it is necessary to know or specify which device functions 11 are associated with a specific control station 2.

In another variant of the invention, the engineering application runs on a computer other than the control station 2 used during operation, with the two computers communicating with one another via the communications network (3, 4, 5) or via some other interface.

In a further advantageous variant, a field device 1 contains a number of associated primary units. For example, switches, disconnectors and transformers in a switch panel are controlled by a single physical field device 1. In this case, the field device 1 in each case has at least one dedicated device function 11 for each primary unit.

LIST OF REFERENCE SYMBOLS

	1	Field device
	2	Control station
5	3	First communications bus
	4	Bus coupler
	5	Second communications bus
	6	Primary unit
	11	Device function
10	12	External interface
	13	Functional description
	14	Algorithm
	15	Internal interface
	21	Engineering application
15	22	Installation representation
	23,23'	Function of the control station
	24	Installation structure
	25	Representation unit
	26	Input unit
20	27	Display unit

000507-1226960

PATENT CLAIMS

5

10

b) functions (23, 23') associated with the field device (1) are installed on the control station (2), and

15

20

25

30

35

6. The method as claimed in claim 1, characterized in that generic functions of the control station (2)

- 20 -

which can be associated with a field device (1) are stored in the control station (2) before the physical installation of the field device (1).

7. The method as claimed in claim 1, characterized in that functions of the control station (2) which can be associated with a field device (1) are transmitted by the field device (1) to the control station (2) during the physical installation of the field device (1).

8. The method as claimed in claim 1, characterized in that generic functions of the control station (2) which can be associated with a field device (1) are transmitted to the control station (2) during physical installation of the field device (1) using an address, in particular a URL (Uniform Resource Locator).

9. The method as claimed in claim 1, characterized in that the installation control system controls a high-voltage or medium-voltage switchgear assembly.

10. An installation control system which has a control station (2) and a communications network (3, 4, 5) for communication with a field device (1), characterized in that the installation control system has

a) means for receiving a standardized functional description (13) of at least one device function (11) of the field device (1),

b) means for installation of functions of the control station (23, 23') which are associated with the at least one device function (11) of the field device (1), and

c) means for configuration of communications links between the at least one device function (11) of the field device (1) and the functions of the control station (23, 23').

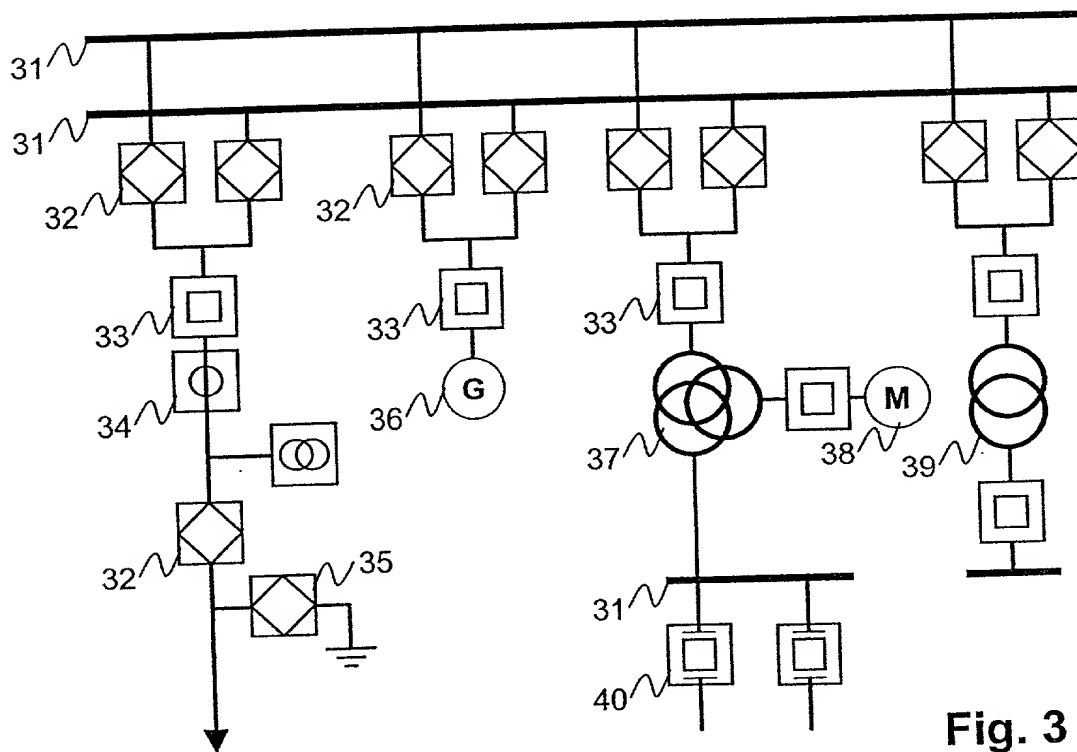
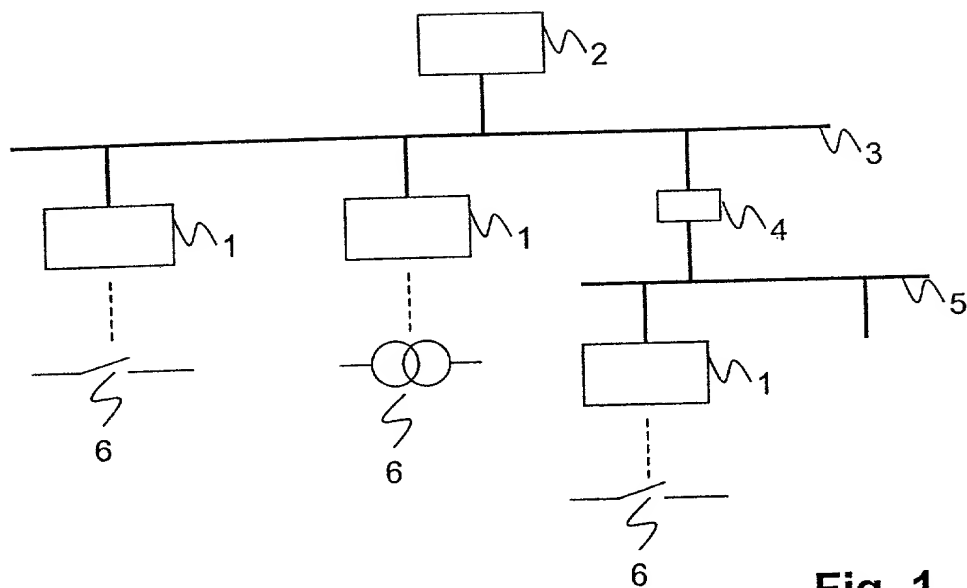
12. A field device (1) for integration in an installation control system, characterized in that the field device (1) has a functional description (13) of at least one device function (11) of the field device (1), and the functional description (13) of the at least one device function (11) of the field device (1) can be transmitted via the installation control system.

ABSTRACT

5 A method and a system for integration of a
field device in an installation control system having a
communications network (3, 4, 5) and a control station
(2) functions in that a field device (1) transmits a
functional description (13) of device functions (11) to
the control station (2) in a standardized form,
whereupon functions (23) associated with the field
10 device are installed on the control station, and
communications links are set up between the device
functions (11) of the field device (1) and the
functions of the control station (23). In one preferred
version of the invention, device functions (11) are
15 automatically or manually combined with an installation
structure (24). The invention is preferably used with
high-voltage or medium-voltage switchgear assemblies
and leads to a considerable reduction in the complexity
for specification and commissioning of installation-
20 internal communications links and to higher quality of
a resulting installation control system.

(Figure 2)

000001 4E2B5960



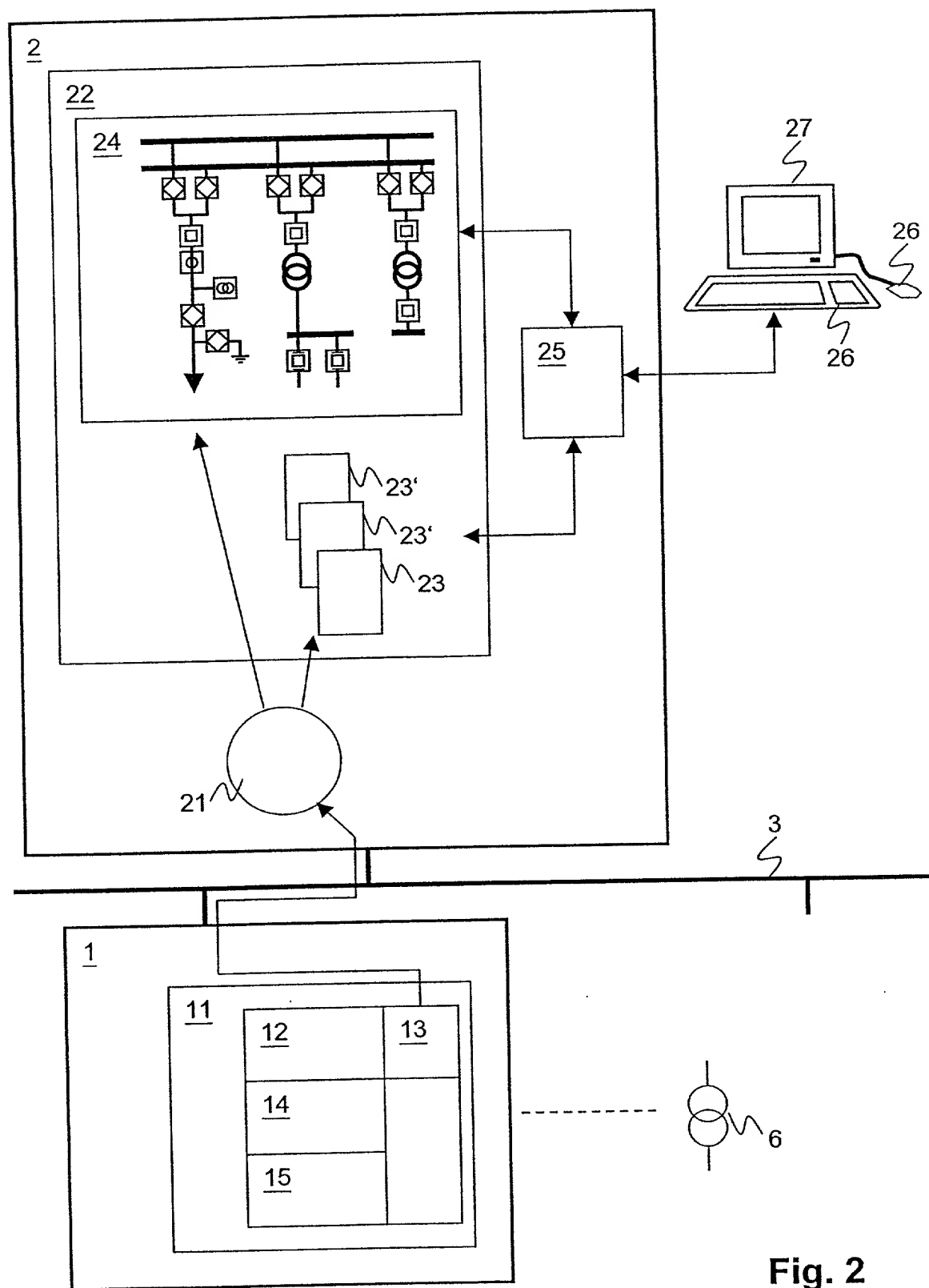


Fig. 2

**COMBINED DECLARATION AND POWER OF ATTORNEY
FOR UTILITY PATENT APPLICATION**

Attorney's Docket No.

004501-446

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I BELIEVE I AM THE ORIGINAL, FIRST AND SOLE INVENTOR (if only one name is listed below) OR AN ORIGINAL, FIRST AND JOINT INVENTOR (if more than one name is listed below) OF THE SUBJECT MATTER WHICH IS CLAIMED AND FOR WHICH A PATENT IS SOUGHT ON THE INVENTION ENTITLED:

INTEGRATION OF A FIELD DEVICE IN AN INSTALLATION CONTROL SYSTEM

the specification of which

(check one)

☒

is attached hereto;

☐

was filed on _____ as

Application No. _____

and was amended on _____;
(if applicable)

I HAVE REVIEWED AND UNDERSTAND THE CONTENTS OF THE ABOVE-IDENTIFIED SPECIFICATION, INCLUDING THE CLAIMS, AS AMENDED BY ANY AMENDMENT REFERRED TO ABOVE;

I ACKNOWLEDGE THE DUTY TO DISCLOSE TO THE OFFICE ALL INFORMATION KNOWN TO ME TO BE MATERIAL TO PATENTABILITY AS DEFINED IN TITLE 37, CODE OF FEDERAL REGULATIONS, Sec. 1.56 (as amended effective March 16, 1992);

I do not know and do not believe the said invention was ever known or used in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to said application; that said invention was not in public use or on sale in the United States of America more than one year prior to said application; that said invention has not been patented or made the subject of an inventor's certificate issued before the date of said application in any country foreign to the United States of America on any application filed by me or my legal representatives or assigns more than twelve months prior to said application;

I hereby claim foreign priority benefits under Title 35, United States Code Sec. 119 and/or Sec. 365 of any foreign application(s) for patent or inventor's certificate as indicated below and have also identified below any foreign application for patent or inventor's certificate on this invention having a filing date before that of the application(s) on which priority is claimed:

COMBINED DECLARATION AND POWER OF ATTORNEY	Attorney's Docket No. 004501-446
---	---

COUNTRY/INTERNATIONAL	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED
EUROPE	99810986.2	01/11/99	YES <u>X</u> NO <u> </u>
			YES <u> </u> NO <u> </u>

I hereby appoint the following attorneys and agent(s) to prosecute said application and to transact all business in the Patent and Trademark Office connected therewith and to file, prosecute and to transact all business in connection with international applications directed to said invention:

William L. Mathis	17,337	R. Danny Huntington	27,903	Gerald F. Swiss	30,113
Robert S. Swecker	19,885	Eric H. Weisblatt	30,505	Charles F. Wieland III	33,096
Platon N. Mandros	22,124	James W. Peterson	26,057	Bruce T. Wieder	33,815
Benton S. Duffett, Jr.	22,030	Teresa Stanek Rea	30,427	Todd R. Walters	34,040
Norman H. Stepno	22,716	Robert E. Krebs	25,885	Ronni S. Jillions	31,979
Ronald L. Grudziecki	24,970	William C. Rowland	30,888	Harold R. Brown III	36,341
Frederick G. Michaud, Jr.	26,003	T. Gene Dillahunt	25,423	Allen R. Baum	36,086
Alan E. Kopecki	25,813	Patrick C. Keane	32,858	Steven M. duBois	35,023
Regis E. Slutter	26,999	B. Jefferson Boggs, Jr.	32,344	Brian P. O'Shaughnessy	32,747
Samuel C. Miller, III	27,360	William H. Benz	25,952	Kenneth B. Leffler	36,075
Robert G. Mukai	28,531	Peter K. Skiff	31,917	Fred W. Hathaway	32,236
George A. Hovanec, Jr.	28,223	Richard J. McGrath	29,195		
James A. LaBarre	28,632	Matthew L. Schneider	32,814		
E. Joseph Gess	28,510	Michael G. Savage	32,596		



and: _____

Address all correspondence to:



21839

Robert S. Swecker
BURNS, DOANE, SWECKER & MATHIS, L.L.P.
P.O. Box 1404
Alexandria, Virginia 22313-1404

Address all telephone calls to: Robert S. Swecker at (703) 836-6620.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

FULL NAME OF SOLE OR FIRST INVENTOR	SIGNATURE	DATE
Otto PREISS		
RESIDENCE		CITIZENSHIP
Zeihen, Switzerland		Swiss
POST OFFICE ADDRESS		
Talhubel 4, CH-5079 Zeihen, Switzerland		
FULL NAME OF SECOND JOINT INVENTOR, IF ANY	SIGNATURE	DATE
Dominik AUF DER MAUER		
RESIDENCE		CITIZENSHIP
Ennetbaden, Switzerland		
POST OFFICE ADDRESS		
Sonnenbergstrasse 10, CH-5408 Ennetbaden, Switzerland		